



FINAL SUBMITTAL

## EXECUTIVE SUMMARY

# ENERGY ENGINEERING ANALYSIS PROGRAM STUDY FORT LEONARD WOOD, MISSOURI

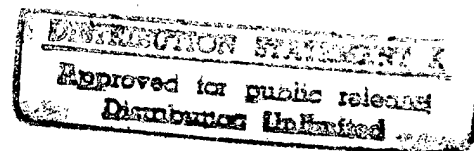
Prepared for

KANSAS CITY DISTRICT  
CORPS OF ENGINEERS  
KANSAS CITY, MISSOURI

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Under

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## **EXECUTIVE SUMMARY**

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EMC No. 3204-000

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## EXECUTIVE SUMMARY

### OBJECTIVE

This Energy Engineering Analysis Program (EEAP) Study is being conducted for the Kansas City District, Corps of Engineers. Its purpose is to determine the energy conservation and economic benefits of expanding the existing Energy Monitoring and Control System (EMCS) to control building mechanical and electrical systems in additional buildings at Fort Leonard Wood.

### ALTERNATIVES

A total of 204 buildings were analyzed to determine the economic benefits of EMCS monitoring and control. Three alternatives were evaluated for expansion of the EMCS at Fort Leonard Wood:

- Alternative 1: Expand the existing HSQ EMCS to the buildings by adding more HSQ hardware, extending the fiber optic (FO) communication loop to these buildings, and programming the data base and control sequences. The system would include the original 45 buildings plus any new buildings which are economically justified.
- Alternative 2: Install a new EMCS in parallel with the existing HSQ EMCS, thus ending up with two EMCS. This would require installing new data transmission from the master control room in Building 2205 to the new buildings, adding hardware in the new buildings, and programming the data base and control sequences. This would have additional costs associated with data transmission, but would likely have more competitive control hardware and software costs. The disadvantage to this alternative would be maintaining two EMCS.
- Alternative 3: Install a new EMCS in place of the existing HSQ EMCS, plus add the new buildings. The new EMCS could utilize the existing data transmission media (DTM), but would incur the costs of installing new field panels in the buildings with HSQ EMCS hardware.

### METHODOLOGY

For each of the 204 buildings, implementation costs, energy savings, and manpower cost avoidance were determined for each heating, ventilation, and air-conditioning (HVAC) system, for each energy management function. Any energy management function which had a poor simple payback was dropped from the project. The remaining implementation costs and energy savings were summarized and the buildings were ranked in order of priority according to the savings-to-investment ration (SIR) of each. A project life cycle cost analysis (LCCA) was then performed for the three alternatives.

## EMCS OPERATIONS AND MAINTENANCE

It is recommended Fort Leonard Wood add two EMCS operators, more formally classified as "utility systems controllers," to operate and manage the additional buildings included in this expansion project.

Correct and continuing maintenance of EMCS equipment is essential if the maximum benefits of the system are to be realized. It is recommended that this equipment be maintained and calibrated under a maintenance contract by a manufacturer's service representative. The costs for additional system operators and a maintenance contract were included in the economic evaluation of the project.

## CONCLUSIONS

Of the 3 alternatives evaluated for 204 buildings, Alternatives 2, a new parallel EMCS, and Alternative 3, a new EMCS, had the best overall economics. The estimated construction cost for Alternative 3, to include the new buildings and upgrade the existing buildings, was \$3,090,807, only \$131,000 more than Alternative 2. There is no difference in economics. A total of 158 new buildings and 3,826 points would be included in Alternative 3. The simple payback for Alternatives 2 and 3 is 3.2 years, with a savings-to-investment-ratio (SIR) of 3.0. See Table ES-1 on page ES-4 for an economic summary of the three alternatives.

## RECOMMENDATIONS

It is recommended that an Energy Conservation Investment Program (ECIP) project be developed to provide a new EMCS at Fort Leonard Wood to control and monitor systems in 158 new buildings, as evaluated in this study, plus replace the existing hardware in the original 45 buildings. Alternative 3 would allow Fort Leonard Wood to have a single EMCS. The benefits of having a single EMCS are in the operation and maintenance of one EMCS, instead of two parallel EMCS. The EMCS should consist of new PC-based front-end computers communicating to building Remote Control Units (RCUs), Auxiliary Control Units (ACUs), and Unitary Control Units (UCUs), to control and monitor 4,959 points, of which 3,826 are new points, and 1,133 are existing points, as described for Alternative 3.

It is recommended that all data transmission media be FO cable. A new data transmission system, consisting of contractor-installed aerial and underground FO cable is recommended for all data communication needs to the 158 new buildings recommended for the EMCS. It is also recommended that the existing FO DTM in the original 45 buildings be reused.

It is recommended that Fort Leonard Wood hire two additional EMCS operators for the EMCS.

## FORT LEONARD WOOD SUPPORT

To be cost effective, the EMCS will need strong support from Fort Leonard Wood. If it does not get this support, large sums of money may be spent on an EMCS that never meets the Fort Leonard Wood cost savings goals. The cost effectiveness of an EMCS depends on several factors, including the following:

- Proper training and motivation of operators to use a large, expensive EMCS.
- Coordination between EMCS operations and DEH personnel, contractors, and others, to reduce both wasted materials and labor, and duplication of effort.
- Basic training of shops personnel to assure their activities do not excessively hinder EMCS operations. Education will enable shops personnel to use the EMCS in their operation and maintenance (O&M) and utilities areas and thereby improve overall cost effectiveness.
- High priority of funding for EMCS maintenance in order to keep the system in good operating condition.
- Obtaining a maintenance contract for EMCS hardware and software.
- Periodic verification and validation of energy and O&M cost savings to ensure that the EMCS is performing as planned.

If successfully implemented, the EMCS can assist all personnel in carrying out their missions. The EMCS can save energy, predict equipment failure, detect equipment failure quickly, and schedule preventive maintenance. Significant potential for cost avoidance exists at Fort Leonard Wood if EMCS administration, operations, and maintenance activities are properly planned and implemented, and if the EMCS is used to its full capability. The existing system has proven that an EMCS will significantly lower utility costs for the Government.

**TABLE ES-1  
SYSTEM ECONOMICS**

SYSTEM ECONOMICS	ALTERNATIVE 1 1993 \$	ALTERNATIVE 2 1993 \$	ALTERNATIVE 3 1993 \$
Anticipated Contract Cost (\$)	\$3,069,264	\$2,654,811	\$2,772,023
Total Investment, Per ECIP Guidance (\$)	3,422,230	2,960,115	3,090,807
Annual Savings (MBtu)	192,551	195,777	195,777
First Year Energy Savings (\$)	1,019,337	1,037,666	1,037,666
Annual Maintenance Manhours Savings (\$)	53,222	58,644	58,644
Annual Electrical Demand Savings (\$)	36,009	38,118	38,118
Annual Staffing Cost (\$)	(66,000)	(66,000)	(66,000)
Annual Maintenance Cost (\$)	(141,147)	(150,866)	(114,533)
Total Non-Energy Annual Recurring Cost (\$)	(117,916)	(120,104)	(83,771)
Net First Year Savings (\$)	901,421	917,562	953,895
Simple Payback (years)	3.8	3.2	3.2
Net Discounted Savings (\$)	\$8,922,780	\$9,074,689	\$9,360,629
SIR	2.6	3.0	3.0

Table ES-2 on page ES-5 provides a summary of identical buildings which were grouped for the purpose of analysis.

Table ES-3 on page ES-6 summarizes the potential energy savings for Alternative 3. Column A of this table lists the savings for the building and systems analyzed in this feasibility study and recommended for connection to the EMCS for Alternative 3. Column B lists the energy usage incurred at Fort Leonard Wood in FY92. Column D lists the percent savings predicted for the EMCS, compared to FY92. Table ES-4 on page ES-6 provides similar information.

**TABLE ES-2  
IDENTICAL BUILDINGS**

<b>BLDG NO.</b>	<b>IDENTICAL BUILDINGS</b>	<b>BUILDING USE</b>
625	650, 658, 732, 740, 750, 753, 822, 825, 838, 842	Battalion HQ
627	628, 629, 634, 635, 651, 652, 654, 659, 660	Barracks, with A/C
730	731, 736, 737, 738	Barracks, w/o A/C
815	816-819, 827-831	Barracks, w/o A/C
1012	1013-1016, 1028, 1029	Barracks, with A/C
1022	1023	Battalion HQ
626	633, 655, 656, 733, 734, 751, 752, 823, 824, 840, 841	Administration/Supply
630	653, 657, 735, 739, 820, 836, 837	Mess Hall
638	832	Clinic
672	673, 680, 681, 772, 773, 780, 781, 872, 873, 880, 881, 990, 991, 998, 999	Motor Pool
1701	1702, 1706, 1707	Administration/Supply
1703	1704	Battalion HQ
1720	1723, 1728, 1729, 1734, 1735, 1761, 1765, 1767, 1769, 1773, 1776	Barracks
1721	1727, 1736, 1760, 1770, 1772	Dayroom
1722	1724, 1725, 1726, 1730, 1731, 1732, 1733, 1762, 1763, 1764, 1766, 1768, 1771, 1774, 1775	Barracks
3211	3212, 3213, 3214	EOQ
4100	4101	BEQ
4102	4104	BEQ
4110	4111, 4112, 4113, 4114, 4115	BOQ

TABLE ES-3  
ENERGY SAVINGS SUMMARY

	(A) ANNUAL SAVINGS	(B) CURRENT USAGE	(C) USAGE AFTER IMPLEMENTATION	(D) % SAVINGS (A)/(B)
Electricity (kWh)	4,893,490	138,025,913	133,132,423	
Electricity (MBtu)	16,701	471,082	454,381	3.5%
LPG (MBtu)	18,861	293,547	274,686	6.4%
No. 2 Fuel Oil (MBtu)	98,345	459,518	361,173	21.4%
No. 6 Fuel Oil (MBtu)	61,870	299,905	238,035	20.6%
Totals (MBtu)	195,777	1,524,052	1,328,275	12.8%

TABLE ES-4  
ENERGY COST SAVINGS SUMMARY

	(A) ANNUAL SAVINGS (\$)	(B) ANNUAL CURRENT USAGE (\$)	(C) % SAVINGS (A)/(B)
Electricity	160,455	5,735,480	2.8%
LPG	106,197	1,652,816	6.4%
No. 2 Fuel Oil	534,977	2,499,686	21.4%
No. 6 Fuel Oil	274,158	1,328,939	20.6%
Totals	1,075,788	11,216,921	9.6%